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ABSTRACT

A systems framework is presented for the evaluation of online bibliographic retrieval services by determining the interrelationships among the procedures in search request processing, the client's gain in knowledge, and the degree of client satisfaction. The application of the framework to an evaluation of the Educational Information System for Ontario (EISO) is described. Findings indicate that the strongest relationships are between process variables such as the number of citations printed and price; price and satisfaction; and between the amount learned and satisfaction. The negative relationship between price and satisfaction suggests that services which charge must be aware that clients are rating the service as well as the product. Future research is needed to discover variables that determine the amount a client learns from a search, since this information would give the search analyst a better understanding of when and how a search should be conducted. (Author/MBR)

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ON 01154

A SYSTEMS EVALUATION OF THE EDUCATIONAL INFORMATION SYSTEM FOR ONTARIO*

BEST COPY AVAILABLE

by

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Ethel Auster
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"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

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Lawton, Stephen B. ; Auster, Ethel ; To, David. -- A Systems Evaluation of the Educational Information System for Ontario. -- Toronto : Ontario Institute for Studies in Education, 1978. -- 33 p. -- (Ministry of Education, Ontario. Contractual Research)

Purpose:

To provide and apply a framework for the evaluation of online bibliographic retrieval services by determining the relationships among the procedures in search request processing, the client's gain in knowledge, and the degree of client satisfaction.

Type of Study:

Descriptive

Sample:

148 searches requested from the Educational Information System for Ontario (EISO) conducted by 1 systems analyst using the Educational Resources Information Centre (ERIC) database. Data collected May 1976 - April 1977.

Methodology:

A systems framework for evaluation, describing the cycle of activities which occur in response to a search request, was constructed and applied. Data on the total sample were collected by a user evaluation questionnaire and a data sheet completed by the search analyst. Path analysis was used to analyze the relations among process and output variables: method of contact (CONTACT); system used (SYSTEM); turnaround times (TURNARND); connect time (CNCTIME); the number of citations printed (CITPRINT); planning search strategy (STRATIME); price; and the amount learned by the client (AMTLRDTC). Client satisfaction was measured by 12 items grouped in 6 subscales including: satisfaction with publicity materials and directions (S1); convenience and helpfulness (S2); timeliness (S3); quality of technology (S4); value of the bibliography (S5); and overall satisfaction (OS). Correlation coefficients; means; standard deviations. Tables; figures.

Findings:

1. Average delay in running a search was 4.3 days; search process time was about 1 hour 10 minutes; average bibliography length was 104 items; approximate cost was $28.00; high OS was expressed.
2. CNCTIME and STRATIME were positively influenced by personal contact with the client, as occurred in 53% of searches.
3. AMTLRDTC and OS were not affected by any process variables.
4. CITPRINT was a significant determinant of price and affected satisfaction.
5. OS was affected by AMTLRDTC and price; S1 and S2 were affected by price, S3 by price, S4 by TURNARND and SYSTEM and S5 by AMTLRDTC.

Conclusions:

1. Payment for searches increases the client's expectations of service; clients' assessment of material provided is independent of the amount paid.

Conclusions...

2. Economies in service could be made by discouraging face to face interviews and restricting the length of the bibliography.
3. Future research is needed into the determinants of knowledge gain experienced by clients.

Special Features:

1. Information System Model ; figure
2. Path Analysis for Process Model explaining client satisfaction ; figure
3. Bibliography -- 9 items

Tests or Instruments Included In Document:
Satisfaction Subscales

Tests or Instruments Used In Research But Not Included In Document:
User evaluation questionnaire; search analyst data sheet

ABSTRACT SUBMITTED TO ERIC

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ABSTRACT

Approaches to the evaluation of online bibliographical retrieval services have taken narrow perspectives and failed to assess the interrelationships of various components of the services. This paper presents a comprehensive framework for such an evaluation, developed using a systems approach. Variables used in the framework include events occurring during a search cycle, role and status, knowledge and opinion, and cost, price and demand. Also described is the application of the framework to the evaluation of the Educational Information System for Ontario (EISO)'s online service in order to determine the relationships between search processing variables associated with costs and output variables measuring the client's gain in knowledge and degree of satisfaction.

Accompanying the widespread introduction of on-line bibliographic retrieval services has been a recognition of the need for their careful evaluation. Several approaches have been taken to this problem including price-demand analyses, organizational studies, data-base evaluations, and end-user evaluations.[1] However, because these studies have taken relatively narrow perspectives, they have failed to assess the inter-relationships of various components of the services in question. In order to facilitate this type of analysis, a comprehensive framework for the evaluation of on-line bibliographic retrieval services is needed. The purposes of this paper are to present one such framework, and to provide an example of its use.

A systems approach was used in developing the framework, incorporating the traditional categories of input, process, output, and feedback. In its application, particular emphasis is placed upon assessing the relationships between variables of interest at different stages, such as input and output, while controlling for the effects of intervening variables. It is hoped that in achieving a better understanding of such relationships, those operating search services can make more rational decisions about policies and procedures.

Systems Framework for Evaluation

In the evaluation framework proposed here, a systems approach is used to describe the cycle of activities that occur whenever an on-line bibliographic retrieval service responds to a client's request. In doing so, four basic questions must be answered. What inputs are required? What processes take place? What outputs are produced? What feedback occurs at each stage? A description of the sequence of events that occur during a search cycle provides answers to these questions.

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The search cycle begins with the submission of a request by a client to the search analyst, a specially trained reference librarian. They then "negotiate" the question, until it can be restated in a form that the search analyst can employ to develop a search strategy that can be used to retrieve relevant citations from appropriate data-bases, such as ERIC or CNTERIS.[2] The analyst then queries the data-base(s) using a retrieval system, such as Lockheed Information System (LIS)'s DIALOG, System Development Corporation (SDC)'s ORBIT, or United Nations Educational Scientific and Cultural Organization (UNESCO)'s CDS/ISIS. When combinations of terms are entered, the number of relevant citations and a few sample citations are printed. If the citations are judged to be relevant to the client's question, the complete bibliography is printed off-line and mailed to the requestor.

The client, on receipt of the bibliography, reviews its contents and makes a personal assessment of its relevance and thoroughness. As a result, a request for original documents may be made. When these are delivered and read, the search cycle, as we define it, is complete.

Feedback may occur at almost any stage of the search cycle. During question negotiation the search analyst makes inquiries and suggestions about the search topic, and the client responds. During the retrieval of references, a discovery that an excessive number of citations have been located, that citations are not relevant to the topic, or that other terms should be used, may cause negotiations to be reopened and the search strategy altered. Even at the end of the entire cycle, feedback occurs when an informed and satisfied (or uninformed and dissatisfied) client returns an evaluation questionnaire.

This cycle of activities forms the system portrayed in Figure 1. At each stage, three "actors" are involved: the client, the search analyst, and

the retrieval system. Each of the three is the referent for a number of variables which describe the characteristics of the search service's inputs, the nature of its processes, and qualities of its outputs.

This systems framework provides a temporal sequence to events occurring during a search cycle, thereby allowing the evaluator to make reasonable inferences about cause and effect relationships. This is important, since policy makers must have a realistic idea of the ultimate effects of different decisions about inputs and the organization of processing activities. In addition, the framework suggests a categorization scheme for variables according to their roles as measures of inputs, processes or outputs. However, it does not provide guidance in the selection of variables to be measured. For this, we turn to the substantive disciplines of sociology, psychology, and economics.

Disciplinary Perspectives

The various academic disciplines offer the evaluator a large number of substantive theories and concepts that might profitably be employed in the selection of variables to be measured and, subsequently, relationships to be analyzed. Those concepts that we felt were of particular value in evaluating a retrieval service were those of role and status from sociology; knowledge and opinion frompsychology; and cost, price, and demand, from economics. The first two in the list provide direction in collecting data on a service's clients; the second two suggest how one might determine the effects of a service on the individual; and the third group identifies factors related to a service's fiscal status. Certainly other concepts could be selected as well, but these seven seemed to be adequate since most of the variables

reported in the literature on search service evaluation could be considered as measures of one of these concepts.

The concept of role as it is used in sociology is not unlike the concept of role in drama. The actor, or person, has a part to play and is expected to behave in certain ways, and not others, both by himself and those around him, i.e., his role set. A person can expect to have many different roles at different times, but typically plays only one role at a time.[3]

By understanding the various roles played by a search service's clients, one can understand and even predict client behavior and reactions. Since requesting a literature search is an act primarily associated with institutional as opposed to private life, it is apparent that the individual's professional roles are of primary interest.

Social status, the second sociological concept used to guide the selection of variables, refers to a person's standing in the community and the deference the person can expect. It has been identified as an important variable in the literature on the work of reference librarians since the reference interview often reverses status positions. In a particular instance, a client who holds a position of high status may be forced to admit to being ignorant, thereby accepting a temporary status inferior to that of the reference librarian. Such a humbling experience may not be easily accepted by senior professors or administrators and their personal reactions might create a barrier to the open communication of their information needs.[4] Ultimately, this could affect their level of satisfaction with the service. For this reason, knowledge of the social status of a service's clients is of value.

The nature of knowledge and the process of learning provide the subject matter for learning psychologists who have developed a number of theories that

might be useful in explaining why an individual requests information and how he or she learns from it. These theories tend to agree on three basic precepts. First, a learner must be motivated to learn. This motivation may be based in the individual's personality (which opens up another realm of psychology) or it may be present in the individual's environment, such as the role the person plays.

Second, a learner must possess some prior knowledge in order to learn a new concept or develop a new understanding. A person almost totally lacking in knowledge about a topic would probably submit an inadequate search request, question negotiation might prove arduous, and the end results might prove less than satisfactory.

Finally, regardless of whether a simple fact or a complex concept involving generalizations and inductive leaps is learned, the learner is changed in the process.

These three generalizations about the learning process emphasize the importance of knowing the extent of a client's motivation, prior knowledge, and new knowledge gained as a result of a given search.

As a search is conducted and the client reviews the results, another psychological process comes into play: the development of opinions. Opinions, which reveal a predisposition to act in a specific way toward some object (the so-called "attitude object"), constitute a major set of output variables. Presumably, opinions about the quality of a search service and its products determine the likelihood of a client's returning to submit additional search requests. Indeed, the recommendation that client satisfaction be assessed on a regular basis is perhaps the most common recommendation in the literature on search-service evaluation.

The concepts of cost, price, and demand, drawn from the field of economics, also guide the selection of specific variables. Costs are typically broken down into fixed costs (or overhead) which represent the dollar expense that continues even when nothing is produced, and variable costs, that are incurred when production is raised to a given level. For a search service, fixed costs include salaries, equipment leases, etc., while variable costs are primarily associated with the charges made by companies providing the retrieval service for connect-time, citations printed, and communications. Costs may be presented as total (aggregate) costs, or in terms of unit costs.

Setting prices has been a controversial and difficult matter for search services, first because library services traditionally have been provided without charge and second because of poor data on total costs. A related concern is the relationship between price and demand. Without knowledge of the elasticity of demand (i.e., the relative change in demand that occurs in response to a change in price) for searches, it is difficult to tell what if any effect different pricing policies may have. Hence, measurement of price and demand are of critical importance in the evaluation of search services.

A wide array of variables must be measured to provide data necessary for various types of economic analyses. Some, such as staff salaries, are input variables which would be used to determine fixed costs. Others, such as the computer connect-time for a given search, are process variables which would be used to compute variable costs and, perhaps, customer prices. These data may be used in their raw form for some analyses or aggregated into totals for others.

In the preceeding description about the way in which concepts drawn from the disciplines of sociology, psychology, and economics can be used to guide

the selection of variables to be measured in evaluating a search service, little was said concerning the level or type of analyses that could be conducted. This omission was purposeful, since it is anticipated that the framework can be applied at different levels and to explore different relationships. In the application that follows, data are treated in disaggregate form; in contrast, an analysis of price-demand would require aggregate data. Also, the application is "inter-disciplinary" in that relationships between several sociological, psychological, and economic variables are investigated, though a discipline-based theory could just have easily been tested. In short, the level at which the framework is applied and the particular analyses carried out depend upon the specific questions the evaluator or researcher is trying to answer.

Application

The remainder of this paper describes an evaluation of certain aspects of a particular on-line bibliographic search service, the Educational Information System for Ontario (EISO), using the systems framework portrayed in Figure 1. The purpose of this particular investigation was to determine the relationships among the procedures followed in processing a search request, and the client's gain in knowledge and degree of satisfaction with the results. Because most of the process variables, such as computer connect-time, are directly related to costs, the relationships in question have a direct bearing on policies and practices involved in operating an efficient and effective search service.

Background

In 1975 the Ontario Ministry of Education, faced with a burgeoning collection of educational research studies which were effectively unavailable to most Ontario educators, committed itself to supporting a wide ranging program aimed at the dissemination of educational research. As part of this program, two activities involving automated services were funded: The Ontario Educational Research Information System (ONTERIS) which was to collect, index, and microfiche research reports, and the Educational Information System for Ontario (EISO) which was to provide access to existing automated bibliographic data bases, such as ERIC, and the new ONTERIS data base.

The contract for creating and evaluating EISO was awarded to the Ontario Institute for Studies in Education (OISE), and the service was given space within the OISE Library, adjacent to the library's journal collection, ERIC microfiche collection, and normal reference service. EISO was designed to be a complete information service to Ontario's professional educational community, supplying access to both bibliographic references and to original documents. Initially, only the ERIC data base was searched via SDC's ORBIT. At that time, long distance phone-calls to the nearest communication node in Buffalo, New York were necessary. Currently four search systems are used regularly to search those data bases most relevant to education, and there is a choice of three different communications networks with local nodes.

Paralleling the creation of EISO itself was the development of a program for its regular evaluation organized according to a systems framework. This evaluation has provided regular feedback to the staff involved, and has formed the basis for deciding a number of policy issues, such as modes of advertising the service and methods of pricing.

The major sources of data used in the evaluation are a user evaluation questionnaire and a data-sheet completed by the search analyst. In all, 13. different variables are regularly collected for each search that is completed. Selection of these items were guided by the discipline based concepts noted earlier. Most were drawn from the literature of previous evaluation studies but only those that were defensible measures of roles, status, knowledge, opinion, cost, price, or demand were included. Where gaps appeared, additional items were developed.[5]

Problem

The relationships among the procedures involved in processing a request and their impact on the client represent a subsystem within the larger evaluation framework, and involve only a fraction of the data collected. Key process variables are the method of contact (CONTACT), the system used to search the data-base (SYSTEM), the length of time required for the search interview and to plan the search strategy (STRATIME), the connect-time (CNCTIME), the number of citations printed (CITPRINT) and price (PRICE). All of these variables except the method of contact relate directly to the cost of operating the service or the price charged. The method of initial contact describes the actions of the client in playing the role of requestor. If it proves to be an important variable in this analysis then a separate investigation using other data that have been collected could be undertaken to determine why different clients contact the search analyst in different ways. Two important variables, the data base being searched and the identity of the search analyst, have been eliminated in this list of process variables

since they are being held constant by limiting the analysis to searches of the ERIC data-base conducted by one search analyst.

The output or dependent variables at issue are the amount learned by the client about the topic searched (AMTLRDTC) and his or her satisfaction (SATIS). In fact, satisfaction was measured with twelve items which were grouped to form five subscales (SATIS1 to SATIS5) measuring client satisfaction with different aspects of the service; a subset of five of these items were added to give an indication of overall satisfaction (SATIS6).

Using the temporal sequence of events provided by the systems framework, we can order the process and output variables and thereby refine the statement of the problem into a series of questions about pair-wise relationships. Method of contact should clearly be the first variable, followed sequentially by strategy time, turnaround time, selection of a system, connect-time, citations printed, price, amount learned, and finally, satisfaction. This sequence does not imply that each variable causes the one that follows; however, within the sequence, there are a number of plausible cause-effect pairings.

Method of contact may have a direct effect on both connect-time and strategy-time since if a person is present in person far more discussion and searching is likely to occur than if contact is by telephone or letter. Connect-time and strategy-time, in turn, could effect the number of citations printed since more time spent on these probably results in a longer bibliography. The number of citations printed might affect both price, if a variable pricing policy is used, and the amount learned by the client, since a longer bibliography may contain more information. And, both price and amount learned might affect satisfaction.

It is unlikely, in contrast, that the system used or turnaround time will affect any of the process variables, though both might well affect satisfaction: turnaround time because long delays might reduce satisfaction, and system used because one might be more effective than the other at retrieving relevant references. If the latter is the case, then the system used may also affect the amount learned by the client. Finally, the amount a client learned might also be positively influenced by the time spent in negotiating and planning the search strategy, independent of the bibliography.

The problem for investigation thus becomes testing the validity of the preceding inferences about cause and effect relationships between different pairs of variables. The particular method selected for this purpose is path analysis.

The path diagram for the relationships described above is displayed in Figure 2. Both temporal sequence and cause-effect relationships are indicated by the flow of the diagram from left to right. Following the conventions of path diagrams, those variables with no predecessors are aligned at the left. The diagram is helpful in showing the flow of action as a search is executed, and in identifying the relationships being investigated. The path coefficients noted on the diagram are discussed later, but it is worthwhile noting the introduction of hypothetical variables (the e's) which represent external variables whose effects are not explained by variables in the model.

Measurement of Variables

Descriptions of the items used to measure the variables included in the path diagram are listed in Table 1. Variables 1 to 7 are process variables; the remainder are output variables.

The first two variables, method of contact (CONTACT) and system used (SYSTEM), are dichotomies and coded as 1 or 0. As a result, care must be taken in interpreting correlation or path coefficients computed between these variables and continuous variables. In the case of CONTACT, a positive correlation between it and a continuous variable would imply that personal contact (coded 1) is associated with high values of the other variable, and other types of contact with low values. Similarly, positive correlations between SYSTEM and a continuous variable would imply use of SDC's ORBIT (coded 1) is associated with high values of the second variable, while use of LIS's DIALOG is associated with low values of that variable.

Turnaround time (TURNARND) is simply the number of days that lapse between receipt of a search request and execution of the search. In practice, the date of each transaction is recorded, and the difference between the two is calculated at the time data are analyzed.

Connect-time in minutes (CNCTIME) and the number of citations printed (CITPRINT), data listed automatically at the end of each search, are transcribed to the data-sheet used for EISO's records by the search analyst. The analyst is also responsible for recording the estimated amount of time spent in question negotiation and planning the search strategy (STRATIME). Because of the complex and iterative nature of these tasks, the figures recorded for STRATIME are probably accurate only within ±15 minutes.

The price (PRICE) charged for each search is recorded in dollars. While this is straightforward, the pricing policies in effect during the period data were collected were not. Four different modes of charging were used:

1. free searches allocated to target groups to encourage trial use of the service,

2. $20 flat rate for clients from a target area located in Northern Ontario,
3. $30 flat rate for searches without an excessive number of citations,
4. $30 plus a surcharge of $.10 per citation for searches with an excessive number of citations.

The policy on charging for an excessive number of citations was applied in a flexible manner by the search analyst. Typically, it was applied whenever the combination of connect-time, communication, and print costs exceeded $45.00.[6] It must be emphasized that pricing policy has a direct effect on the types of relationships one can expect to find. Because most EISO clients received searches for either $30 or nothing during the period under consideration, any effect of PRICE on other variables will be interpretable as the effect of charging $30 as opposed to providing free service.

The amount a client learned about his or her topic (AMTLRDTC) as a result of undertaking a search was tapped by the straightforward question listed as variable 8. As with other one-item variables, it is not possible to compute a reliability coefficient for this measure. However, its validity was confirmed by correlating responses on it with questions about the number of original documents read, and the percentage of information that was new to the client. Correlations coefficients were .36 and .40 respectively, both significant at the .05 level.

Measurement of client satisfaction with various aspects of the search service were measured by five subscales (SATIS1 to SATIS5) consisting of scales that included satisfaction with publicity materials and directions (SATIS1), with convenience and helpfulness (SATIS2), with timeliness of service (SATIS3), with the quality of technology (SATIS4), and with the value of the bibliography (SATIS5).

Individual items used in constructing subscales are reported in Appendix A, and include those used in the scale used to measure overall satisfaction (SATIS6). The latter scale used five items selected from the subscales; not all items were included because many clients had not been exposed to all aspects of the service and therefore had failed to respond to some items. Instead, only those items referring to matters to which all clients had been exposed were included in the scale.

Reliability coefficients for the six scales were .80, .62, .78, .27, .79, and .80 respectively. Overall, these coefficients are sufficiently high for the scales to be used in assessing the satisfaction of EISO's clients with the service.

Methodology

Path analysis was selected to analyze the relationships among process and output variables because it provides a method of testing the validity of causal inferences for pairs of variables while controlling for the effects of other variables.[7] In addition, path diagrams provide heuristic portrayals of systems relationships which are well suited to the systems framework used to organize the variables in this study.

The particular technique used in this investigation follows the practices advocated by Goldberger.[8] In particular the path coefficients presented here are the standardized regression coefficients resulting from regression of the dependent variable in question on those variables directly affecting it, and those alone. In cases where there is but one predecessor variable, the path coefficient is identical to the zero-order correlation coefficient; in other

cases it is equivalent to the partial correlation coefficient of the dependent variable on the standardized predecessor variable controlling for other variables directly affecting the dependent variable.

The amount of unexplained variance in any dependent variable X_i is assumed to be accounted for by hypothetical "error" variables denoted by e_i. The correlation between e_i and X_i is equal to $1 - R^2$ where R^2 is the multiple correlation between X_i and all predecessor variables directly affecting it.

Not all relationships in a path analysis are analyzed. First, those relationships for which no causal inferences are plausible may be omitted. Second, relationships between exogenous variables (in this case X_1, X_2, and X_3) are typically unanalyzed, though they are sometimes controlled for if they are considered to interact with one another. Finally, correlations among the e_i are assumed to be zero and remain unanalyzed.

Path analysis requires three principal assumptions which may or may not be valid. First, all relationships are assumed to be linear; second, relationships are assumed to be additive; and third, it is assumed no interaction (i.e., multiplicative effects) exists among variables. As well, some authors would hold that the variables are assumed to be measured on a ratio scale with some fixed unit of measure.

For the dichotomous variables (CONTACT and SYSTEM) and those measured in standard units of measure (TURNARND, CNCTIME, STRATIME, CITPRINT, and PRICE) none of the assumptions would be violated. Those measured on Likert scales (AMTLRDTC and SATIS) may violate assumptions as to linearity and unitary measurement. However, because monotonic, if not linear, relations are expected for all relationships involving these variables, violation of the first assumption would, at worst, cause the relationships to be underestimated.

Sample

The population for this study is the universeof all 371 searches requested from the Educational Information System for Ontario between May 1, 1976 and April 30, 1977. Though some data were available on all searches, the present analysis was restricted to those which had been run on ERIC and for which the requestor had returned an evaluation questionnaire. The total number was 148 (40 percent of all searches), but missing responses on some variables result in a smaller number being used for some analyses.

Virtually all searches were placed by clients from the professional education community in Ontario, which EISO was designed to serve. In general, 40 percent of EISO's clients were from school boards, 40 percent were from OISE, 10 percent from other universities and faculties of education, and 10 percent miscellaneous. Approximately 30 percent of the clients reported that they were engaged in administration, 17 percent in teaching, 12 percent in research, 18 percent in graduate study, 7 percent in librarianship, and 14 percent other.

Findings

In this section we shall proceed from the general to the specific, presenting first the findings for the path analysis in which overall satisfaction (SATIS6) is the dependent or output variable, and then the results for the five satisfaction subscales.

Table 2 lists the correlation coefficients, means, and standard deviations for the nine variables that appear in the path diagram in Figure 2. Several of the means need interpretation to be understood. For CONTACT, $\bar{X} = .53$ implies 53 percent of all clients contacted the search analyst in person;

similarly, the mean of .19 for SYSTEM implies only 19 percent of all searches were done using SDC's ORBIT while the remaining 81 percent were carried out using LIS's DIALOG.

The average delay in running a search was 4.3 days, but the actual search process took about an hour and 10 minutes, including 46 minutes for interviewing and planning the strategy, and 24 minutes for running the search. The average bibliography included 104 items, and cost the client $28, though this average is of questionable use since most clients either received the search free (9 percent) or paid $30 (82 percent). The average client learned "something" about the topic searched (since at 2.2 the mean for AMTLRDTC is near the middle of the three-point scale) and expressed high overall satisfaction (2.6 on a scale of 3).

We will not analyze the correlations in detail since that is the purpose of the path analysis. However, we would note that initially, only the amount learned about the topic has a significant zero-order correlation with overall satisfaction.

Path coefficients for analyzing the causal effect of the seven process variables on the two output variables, AMTLRDTC and SATIS6, are included in Figure 2, where each causal path is indicated by an arrow. The most informative paths are those that can be traced from CONTACT through CNCTIME and STRATIME to CITPRINT, AMTLRDTC, and PRICE, and finally to SATIS6.

Both CNCTIME and STRATIME are positively influenced by the personal contact with the client, but the effect of this on the number of citations printed is relayed almost solely through connect-time. The amount learned about the topic searched (AMTLRDTC) does not appear to be affected by any of the process variables. The small negative coefficient between it and SYSTEM, which might

imply that SDC was less effective than LIS (as our search analyst fervently believes), is not statistically significant. Similarly, the positive coefficient from CITPRINT, which would imply more is learned from long bibliographies, is not statistically significant.

CITPRINT is a statistically significant determinant of PRICE as would be expected given the pricing policy in which charges for an "excessive" number of citations are made. Other variables which might affect price, such as being in one of the target groups receiving free searches, are excluded from the model but are represented by e_i.

Finally, five causal variables impact upon overall satisfaction (SATIS6) but only two of these relationships are statistically significant: those for AMTLRDTC and PRICE. The first has a positive effect, with those clients who learned more about their topic having a more positive viewpoint. But, controlling for CITPRINT, AMTLRDTC, SYSTEM, and TURNARND, those who paid a higher price were less satisfied overall. That is, all other things being equal, the client who paid a higher rate would report lower overall satisfaction than one who paid a lower rate. Thus, though price did not appear as an important variable in the zero-order correlations, it does appear as a determinant in the final analysis. Of the remaining variables which we thought might affect overall satisfaction, namely TURNARND, SYSTEM, and CITPRINT, a possible relationship is indicated only for the last. Taking the three branches from CITPRINT together, it might be suggested that it does affect satisfaction, with its positive effects being felt both directly and indirectly via the path through amount learned, and its negative effects felt via the path through price.

Table 3 lists the path coefficients for the process models in which not only overall satisfaction is the dependent variable of interest, but also the subscales measure specific characteristics of the search service, SATIS1 through SATIS5. In the table, paths are named with the effect variable first and the causal variable second. The subscripts also reflect this ordering, e.g., p_{41} is the coefficient measuring the effect of X_1 (CONTACT) on X_4 (CNCTIME). An exception to this rule occurs when the correlations remain unanalyzed, as between the pairs of exogenous variables X_1 to X_3. For these variables, the zero-order correlation coefficients are presented.

Means, standard deviations, and sample sizes are also given in Table 3. Sample sizes vary according to the satisfaction subscale being considered since not all clients were exposed to all facets of the service, and hence did not respond to some evaluation questions.

Path coefficients for the first eleven paths for the five satisfaction subscales are, in fact, estimates of the same path coefficients already considered in the diagram explaining overall satisfaction. Any variation from earlier estimates is due to variation in the samples on which the estimates are based. In fact, the new estimates are quite similar to the earlier ones, except for the sample size of 31 on which estimates for path coefficients leading to SATIS3 are based. This is to be expected given the small sample size, and serves as a warning against placing too much confidence in estimates drawn from this subsample.

The last five coefficients in each column of Table 3 do present new path coefficients which measure the effects of SYSTEM, TURNARND, CITPRINT, PRICE, and AMTLRDTC on the satisfaction subscales.

Starting with SATIS1, the degree of satisfaction with publicity materials and directions, we note that only PRICE seems to have an effect, and, as before, the effect is negative. A similar conclusion holds for SATIS2, the convenience of the service and helpfulness of its staff.

CITPRINT, PRICE, and AMTLRDTC all have significant effects on the satisfaction of the 31 clients who responded to SATIS3 which measured the timeliness of the service, including document delivery from EDRS and EISO. These coefficients are similar to those noted for overall satisfaction, but are somewhat longer.

In contrast to the preceding case, only TURNARND, and SYSTEM apparently affect SATIS4, which tapped client satisfaction with the quality of the technology, as measured by the length of the bibliography, readibility of microfiche, and availability of microfiche readers.

Satisfaction with the value of the bibliography and materials located (SATIS5) was apparently affected by only one variable, the amount learned about the topic. It is notable that, for this specific attitude object -- the value of the bibliography and materials located through it -- the negative effect that price had on other types of satisfaction disappears.

Discussion

How successful is the process model at explaining client satisfaction? We are embarrassed to admit, having put considerable effort into its development and testing, that it is only partly effective at doing the job for which it was intended. Fortunately, it does provide additional information that increases its overall usefulness.

As far as satisfaction is concerned, only one variable seems to have a consistent effect, namely price. The negative effect of price on satisfaction was apparent with overall satisfaction, and satisfaction with particular components of the service: publicity materials and directions, convenience and helpfulness, and timeliness. It did not affect satisfaction with the technology or materials produced. In interpreting this differential effect of price, it must be recalled that 9% of all users received free searches, and most others paid $30 or more. It would appear, then, that when individuals are paying for bibliographic search, they expect more in the way of service than they would if they were receiving it for free. Yet, it is important to note that their expectations with regard to service do not carry over to their assessment of the value of the goods, which they apparently assess independently of amount paid.

We are at a loss to account for the three other significant relationships between process variables and satisfaction scores (SYSTEM and TURNARND with quality of technology, SATIS4; and CITPRINT with timeliness of service, SATIS3). We are inclined to ascribe them to anomalies in the smaller samples involved, or to extraneous variables not in the analysis.

There is, of course, another variable which is related to various satisfaction scores with some consistency, the amount learned about the topic searched (AMTLRDTC). This variable is an output variable in its own right, but intervenes between satisfaction and all process variables except price. It is positively related to overall satisfaction, satisfaction with timeliness of service, and most important, satisfaction with the value of the bibliography and materials. This last relationship helps to validate the satisfaction items, since one would expect a person who learns more than another from a

bibliography to be more satisfied with it. But more important, it highlights the idea that the client is motivated to learn, and that if this learning does not occur, dissatisfaction will result.

Though the amount learned has proven to be an important intervening variable explaining client satisfaction, none of the process variables helps to account for the extent of learning that takes place. This failure to account for variation in learning is an important finding in and of itself, since the following possible causes are ruled out: the system used, number of citations printed, and interview/strategy time. It would appear that explanations must be sought in the personality of knowledge of the client, the interaction between the client and search analyst, the quality of the search strategy, or the topic being searched.

Relationships for the remainder of the process model have been confirmed. Price is affected by the number of citations printed; the number of citations printed is affected by connect-time -- but not interview and strategy time; and both connect-time and interview/strategy time are affected by the method of contact. If there is a surprise here, it is that while the personal contact is responsible for taking a considerable amount of the search analyst's time, the production of longer bibliographies and higher prices, it seems to bear no relationship to either the amount learned or the level of satisfaction.

Implications

There are two findings in this study which seem of immediate import to the search service manager, and one with implications for future research.

First, it is apparent that any search service which charges for its product must emphasize the service as well as the search. It is not enough

to provide customers with a bibliography and materials, but it must be done in a way that makes the client realize he is paying as much for the service as for the product, and that he is getting his money's worth. Indeed it can be argued that clients only pay for the service, since what is paid is related not to the ultimate worth of the material, but to the cost of its retrieval.

Second the finding that process variables have no clear relationship to client satisfaction or the amount a client learns, suggests that, where necessary, economies may be possible by discouraging face-to-face interviews (which take more time) and by restricting the length of bibliographies as much as possible. These recommendations, if imposed on a staff, would probably fail (we speak from experience). But for search analysts who are responsible for their own budgets and who must defend their existence at least in part on the basis of the number of clients served, it may be encouraging to note that it is probably possible to cut a few corners without harming the quality of the service.

Finally, the need for future research into the determinants of the gain in knowledge experienced by clients as a result of bibliographic searches is apparent, given its strong relationship with client satisfaction. While libraries and information centres have traditionally defined their roles as providers of information, with no guarantee that their clients benefit from this information, it appears that for search services to succeed in satisfying their clients needs, a better understanding of the personal and psychological factors involved is needed. In particular, if it is possible to establish in advance the likelihood of a search's success in filling a client's needs, then search analysts may be able to better distinguish between those clients who are likely to profit and those who are not.

Limitations

The suggestions above were presented without qualification, but it should be emphasized that they are made within the context of a single search service, EISO, serving a special population, the professional educational community in Ontario, Canada. Given the nature of its client group, EISO's staff primarily conducts in-depth, retrospective searches requested as a basis for research reports or background studies. The length of search interviews, connect-time, and the number of citations printed tend to exceed norms reported in the literature, but are not, we feel, out of line with the task.[9] Nevertheless, given EISO's norms, it may well be that it can cut corners without damaging the quality of service, whereas another service could not. Therefore, the conclusions and recommendations made here should not be considered as conclusions of general applicability.

Summary

The systems framework for evaluating an on-line bibliographic search service described in this paper was successfully applied to describe the relationships among a number of process variables associated with the costs of operation, and output variables measuring the clients' gain in knowledge and satisfaction. Strongest relationships were between process variables such as the number of citations printed and price, between price and satisfaction, and between the amount learned and satisfaction. The negative relationship between price and satisfaction, which did not apply to satisfaction with the bibliography and materials themselves, suggests that services which charge must be aware that clients are rating their service as well as their product.

Future research is needed to discover variables that determine the amount a client learns from a search, since this information would give the search analyst a better understanding of when and how a search should be conducted.

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[6]All prices are in Canadian dollars.

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[9]Wax, David M. 1976. Op. cit., p. 13.

APPENDIX A

Items Used in Six Satisfaction Subscales

Question: Please indicate your satisfaction with the following elements of your EISO search.

SATIS1 - Publicity Material and Directions

a. Convenience of arrangements and adequacy of directions

b. Accuracy and comprehensiveness of publicity materials

c. Adequacy of directions for ordering materials

SATIS2 - Convenience and Helpfulness

a. Convenience of arrangements and adequacy of direction

b. Helpfulness of the search analyst

SATIS3 - Timeliness of Service

a. Time taken to deliver bibliography

b. Time taken to deliver materials from EDRS

c. Time taken to deliver materials from EISO

SATIS4 - Quality of Technology

a. Length of bibliography

b. Readibility of microfiche copies

c. Availability of microfiche readers

SATIS5 - Value of Bibliography and Materials

a. Bibliography itself

b. Materials created via bibliography

SATIS6 - Overall Satisfaction

1a, 2b, 3a, 4a, 5a

Scale scores were adjusted for the number of items by dividing total scale scores by the number of items. Scale: Low = 1; medium = 2; high = 3; NA = 4.

TABLE I

Process and Output Variables Used in Search Service Evaluation

No.	Variable Name	Item Description and Coding
1	CONTACT**	In person - I Other - 0
2	SYSTEM	SDC ORBIT - I LIS DIALOG - 0
3	TURNAROUND	Turnaround time in days between receipt of request and on-line searching
4	CNCTIME	Connect-time in minutes
5	STRATIME	Interview and strategy time in minutes
6	CITPRINT	Number of citations printed
7	PRICE	Price charged in dollars
8	AMTLRDTC	How much did you learn about your topic as a result of the search? (1) ___ Nothing or very little (2) ___ Some (3) ___ A great deal
9	SATIS6*	Overall satisfaction
10	SATIS1	Satisfaction with Publicity Materials and Directions
11	SATIS2	Satisfaction with Convenience and Helpfulness

12	SATIS3	Satisfaction with Timeliness of Service
13	SATIS4	Satisfaction with Quality of Technology
14	SATIS5	Satisfaction with Value of Bibliography

**Variables 1 through 7 recorded by search analyst on data sheets. Variables 8 through 15 indicated by client on User Evaluation Questionnaire.

*See Appendix A for complete list of satisfaction items and construction of subscales.

TABLE II

Correlation Matrix, Means and Standard Deviations for Variables in Process Model Explaining Overall Satisfaction with Service

		X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
X_1	CONTACT									
X_2	SYSTEM	.005								
X_3	TURNAROUND	.049	-.302							
X_4	CNCTIME	.357	-.118	.095						
X_5	STRATIME	.474	-.295	.465	.433					
X_6	CITIPRINT	.296	-.032	.117	.530	.341				
X_7	PRICE	.086	.070	.151	.311	.309	.621			
X_8	AMTLRDTC	.025	-.097	.006	.055	.044	.117	.039		
X_9	SATIS6	.036	.003	.060	.079	.038	.120	-.049	.394	
Mean		.531	.193	4.31	24.2	46.2	104	28.3	2.19	2.61
Std.Dev.		.501	.396	4.26	14.5	26.3	111	13.1	0.62	.32

N = 148

** $p < .01$

* $p < .05$

TABLE 3

Path Coefficients for Process Model Explaining Subscale Scores for Satisfaction with Service

	Path	Statistic	Variable					
			SATIS1	SATIS2	SATIS3	SATIS4	SATIS5	SATIS6
1.	CONTACT-SYSTEM	r_{12}	.03	-.01	-.23	.16	.06	.00
2.	CONTACT-TURNARND	r_{13}	-.00	.03	.19	-.19	-.06	.05
3.	SYSTEM-TURNARND	r_{23}	-.27**	-.29**	.01	-.32**	-.34**	-.30**
4.	CNCTIME-CONTACT	P_{41}	.29*	.32**	.28	.20	.34**	.36**
5.	STRATIME-CONTACT	P_{51}	.39**	.41**	.21	.34**	.40**	.47**
6.	CITPRINT-CNCTIME	P_{64}	.47**	.46**	.44*	.62**	.56**	.47**
7.	CITPRINT-STRATIME	P_{65}	.15	.14	.21	-.04	.03	.14
8.	PRICE-CITPRINT	P_{76}	.66**	.61**	.29	.57**	.50**	.62**
9.	AMTLRDTC-SYSTEM	P_{82}	-.13	-.11	-.33	-.04	-.14	-.10
10.	AMTLRDTC-STRATIME	P_{85}	-.06	-.01	-.04	-.08	-.03	-.03
11.	AMTLRDTC-CITPRINT	P_{86}	.15	.15	.02	.01	.05	.14
12.	SATIS-SYSTEM	P_{92}	.04	.04	.21	.32*	-.05	.09
13.	SATIS-TURNARND	P_{93}	.03	.05	.08	.26*	.09	.09
14.	SATIS-CITPRINT	P_{96}	-.13	.14	.41*	-.01	.03	.18
15.	SATIS-PRICE	P_{97}	-.24*	-.22*	-.39*	-.11	-.06	-.20*
16.	SATIS-AMTLRDTC	P_{98}	-.08	.09	.43**	.11	.67**	.38**
	N		148	157	31	70	139	145
	$\bar{X}$		2.60	2.75	2.40	2.59	2.32	2.61
	S		.42	.42	.45	.37	.67	.32

** $p < .01$

* $p > .05$

FIGURE 1. Information System Model

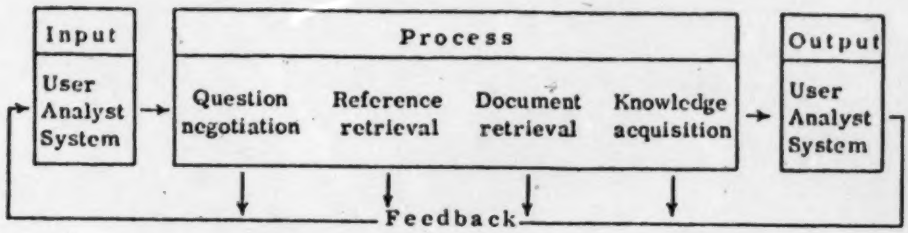
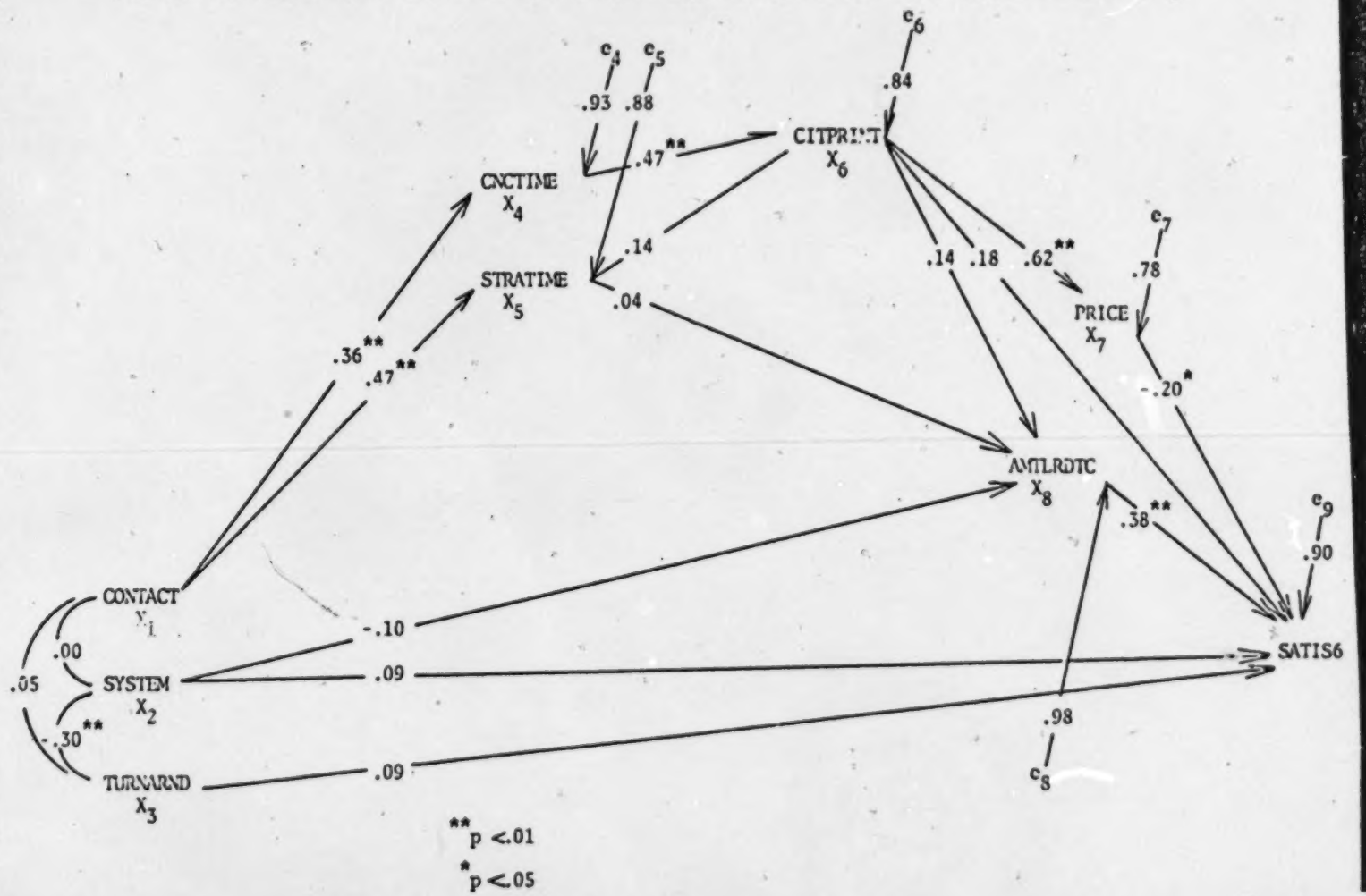
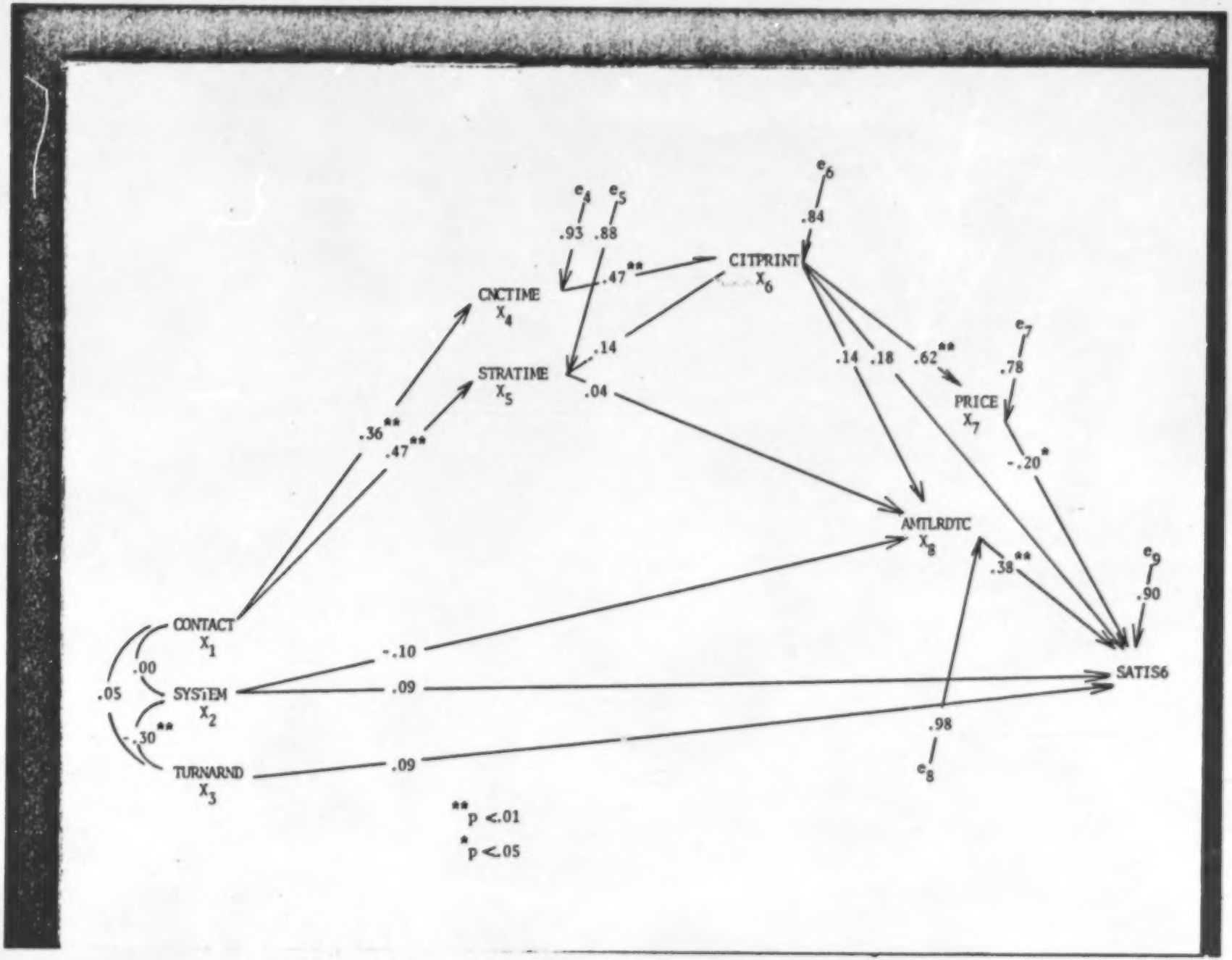


FIGURE 2. Path Analysis for Process Model Explaining Client Satisfaction with Search Service




e4
e5
e6
.93
.88
.84
CITPRINT
X6
.47**
CNCTIME
X4
.14
.14
.18
.62**
e7
.78
STRATIME
X5
.04
PRICE
X7
.36**
.47**
-.20*
AMTLRDTC
X8
.38**
e9
.90
CONTACT
X1
-.10
.00
.05
SYSTEM
X2
.09
SATIS6
-.30**
.98
TURNARND
X3
.09
e8
**p <.01
*p <.05